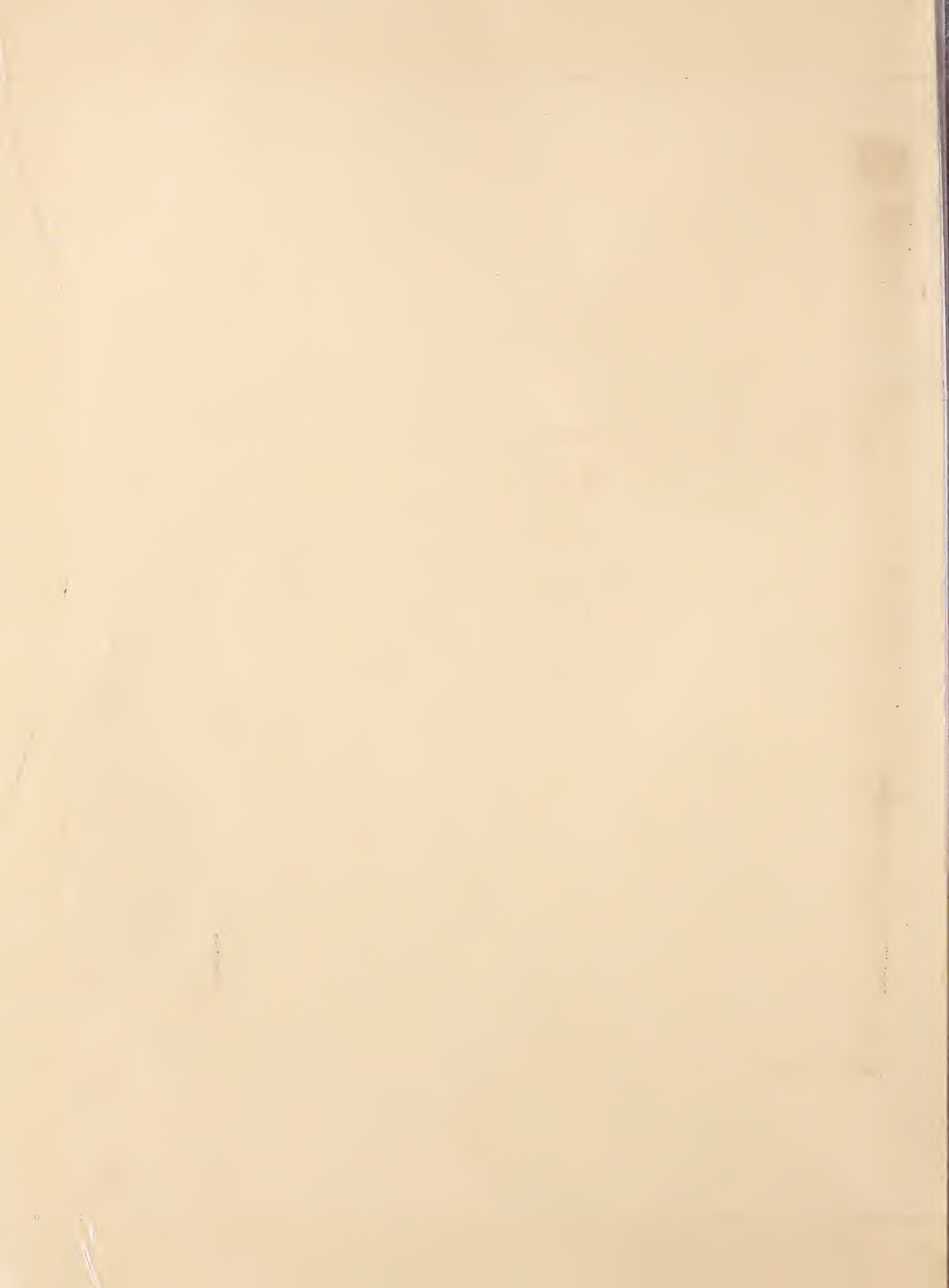


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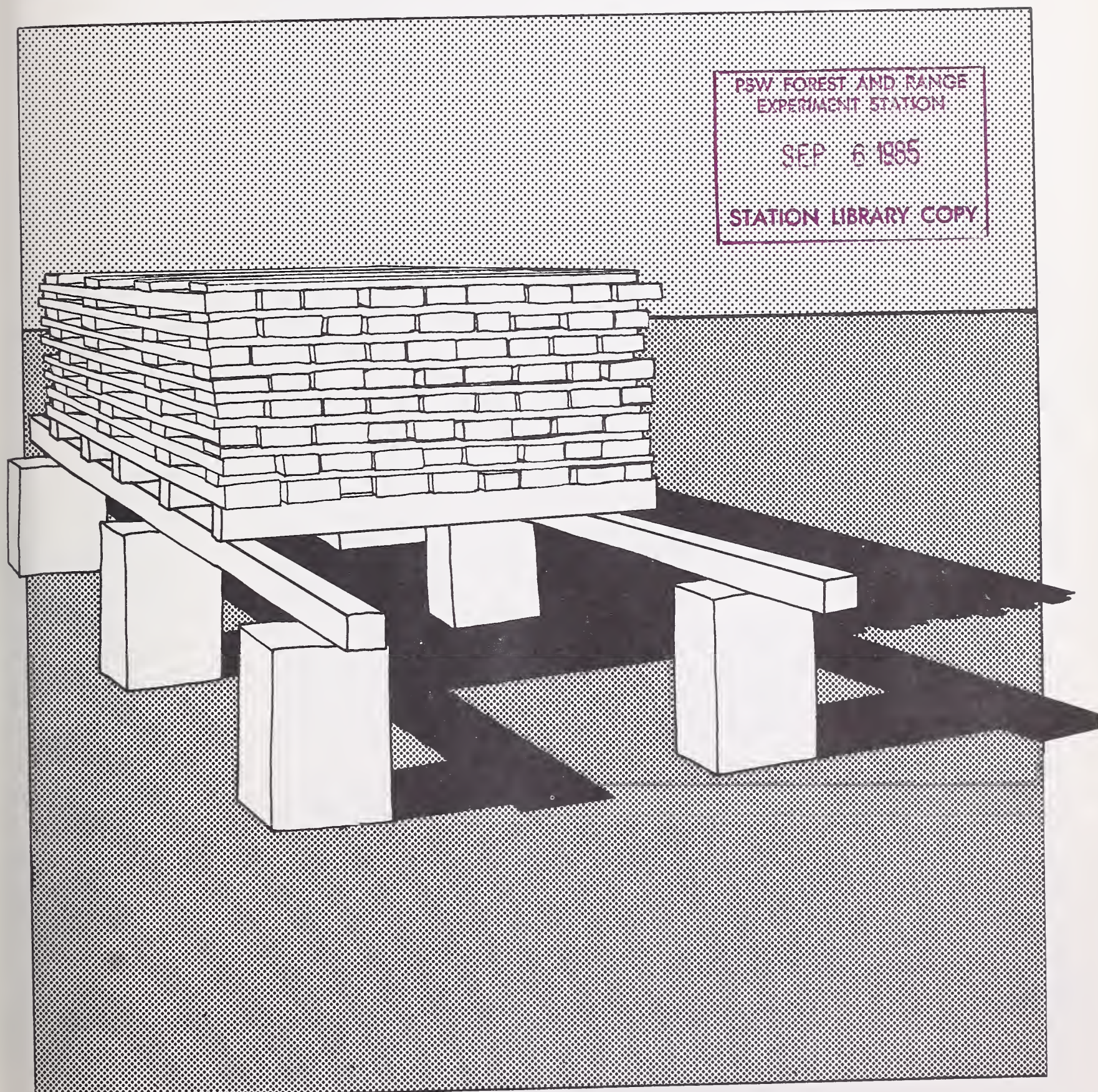
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# Air Drying of Softwood Lumber, Fairbanks, Alaska

George R. Sampson and Forrest A. Ruppert





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## Abstract

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Air-drying rates for two stacks of 2-inch-thick white spruce were observed in the Fairbanks area during summer 1982. The air-drying rate for the same size lumber was also observed during winter 1982-83. Very little drying occurred during the winter. Drying rates in summer were correlated with average daily temperature and average daily dew point to derive predictive equations. A hypothetical mill production and sale schedule are used to show possible effects of kiln drying on required inventory.

Keywords: Air dry lumber, white spruce, Alaska (interior), interior Alaska.

## Summary

Softwood dimension lumber produced in interior Alaska is sold as rough lumber or is air dried before planing. To determine air-drying time as related to average daily temperature and average daily dew point, two piles of 2-inch-thick white spruce lumber were monitored as they air dried during summer 1982. One pile began drying near the end of May and another began drying near the end of July. An experiment with a similar pile of green lumber began in mid-December to determine if significant drying occurs during winter.

The pile that began drying in May was dry ( $< 19$  percent moisture content) within a month. The pile that began drying in July had an average moisture content of 18 percent within 70 days, but even then more than 5 percent of the volume had a moisture content  $> 19$  percent. The pile that began drying in December still had a moisture content  $> 50$  percent after 70 days.

Drying rates in summer were correlated with average daily temperature and average daily dew point to derive predictive equations that could be used with daily or monthly averages.

A hypothetical monthly production and sale schedule for a sawmill producing 7.9 million board feet per year were used to show possible effects of kiln drying on required inventory. Air drying would result in an average monthly inventory of more than 6 million board feet. Using a dry kiln could reduce the average monthly inventory to 1.25 million board feet with the same production and sales schedules.

## Current Status

Annual production of softwood lumber in Alaska, from Seward northward, amounts to about 15 to 20 million board feet. There is one dry kiln that handles a small amount of this lumber each year. The remainder is marketed as air-dried finished lumber or as rough green. Each year about 80 million board feet of finished softwood lumber is imported to Alaska from the Pacific Northwest and Canada. If locally produced lumber is to be used in increasing amounts in future years, it will have to be dried and finished. Air drying offers one option for producing this finished lumber. Sawmills near Fairbanks use a rule of thumb that 2-inch-thick lumber will air dry to a moisture content of 19 percent or less in 2 months during summer and will dry little if any during winter.





Methods

To determine actual summer drying time in the Fairbanks area and relate that drying time to average daily temperature and dew point, two batches of 2-inch-thick white spruce lumber, 8 feet long, were obtained from a local sawmill in 1982. For each batch, individual pieces were selected for monitoring of moisture content. Initial moisture content for each piece was determined as suggested by Rietz and Page (1971).

The first batch of lumber began drying on May 27. This batch had 80 pieces in an equal number of 2 by 4's and 2 by 6's. Eight 2 by 4's and eight 2 by 6's were used for determining moisture content. The air-drying location was an open field with a gently sloping southern exposure. Changes in moisture content were determined by weighing sample pieces at intervals of 4 to 8 days throughout the drying period.

The second batch of lumber began drying on July 27 (fig. 1). This pile was of the same height and width as the first, but eighteen 2 by 6's were selected for determining drying rate.

To test drying rates of lumber during winter, 14 green, white spruce 2 by 4's were placed in a large shed that was open on the south side. This batch was put in place on December 13, 1982.

In all cases, the lumber selected for drying was taken from the green chain of a local sawmill and had widely varying initial moisture contents in the individual pieces.



Figure 1.—White spruce lumber stacked for air drying, July 27.

The drying data for summer were analyzed using regression analysis. The variables considered were the difference between average daily temperature and average daily dew point (in °C) and the average daily moisture content of the lumber during the observation period. The following model was selected for analysis of individual piece drying:

$$\text{MCLOSS} = f(M, T, D)$$

where:

$$\begin{aligned} \text{MCLOSS} &= \text{average loss (percent of moisture content for the day,} \\ M &= \text{moisture content of lumber at the end of the previous day (expressed as weight of water in lumber divided by the oven-dry weight of lumber),} \\ T &= \text{average temperature for the day (°C), and} \\ D &= \text{average dew point for the day (°C).} \end{aligned}$$

## Results

The observed drying rates for each lumber batch are shown by figure 2. The differences among the rates are a direct reflection of differences in temperature and relative humidity. A subjective interpretation of these observations indicates that lumber carried through the winter probably could not be expected to be down to 19 percent moisture content before the end of May. Lumber produced during April and May would probably be dry by the end of June, and lumber produced during June would probably be dry by the end of August. July production should be dry by the end of September. Lumber produced after July would probably not be dry until the following May.

These contentions are generally borne out by the data in figure 3, which shows the predicted lumber drying rate during summer months, based on monthly average temperature and dew point for Fairbanks. Generally, effective air-drying conditions for lumber are available from mid-April through September in the Fairbanks area. The equation derived for lumber having a moisture content  $\geq 30$  percent is:

$$\text{MCLOSS} = -0.973 + 0.010M(T-D); \quad (1)$$

$$R^2 = 0.77.$$

For lumber having a moisture content  $< 30$  percent the equation is:

$$\text{MCLOSS} = -0.240 + 0.016 (M^2 (T-D)) \div 100; \quad (2)$$

$$R^2 = 0.78.$$



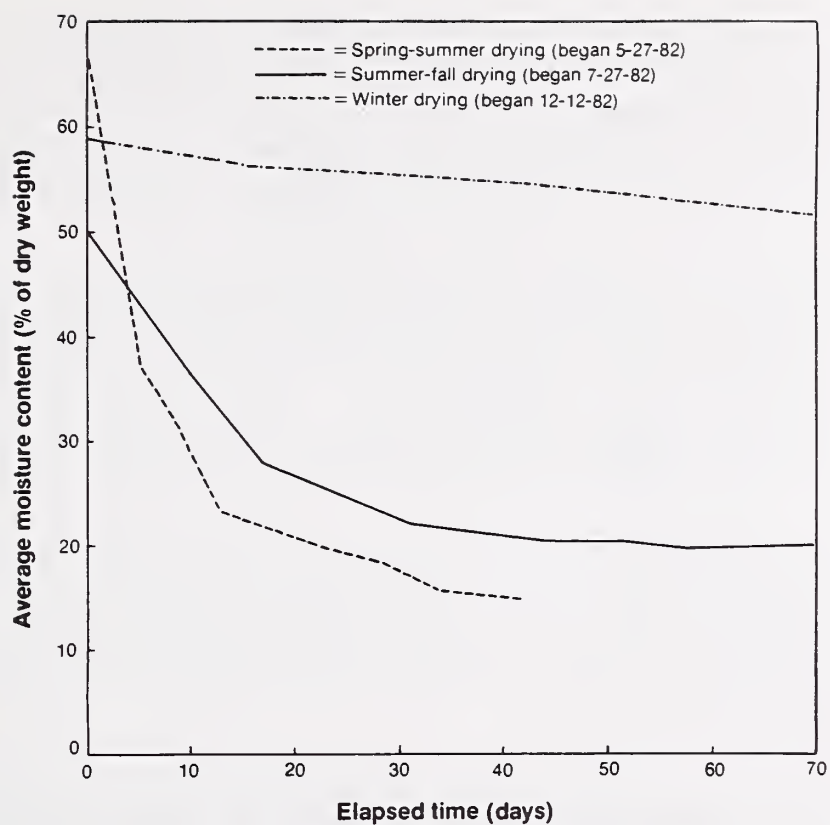


Figure 2.—Three trials of air drying white spruce dimension lumber, Fairbanks, Alaska.

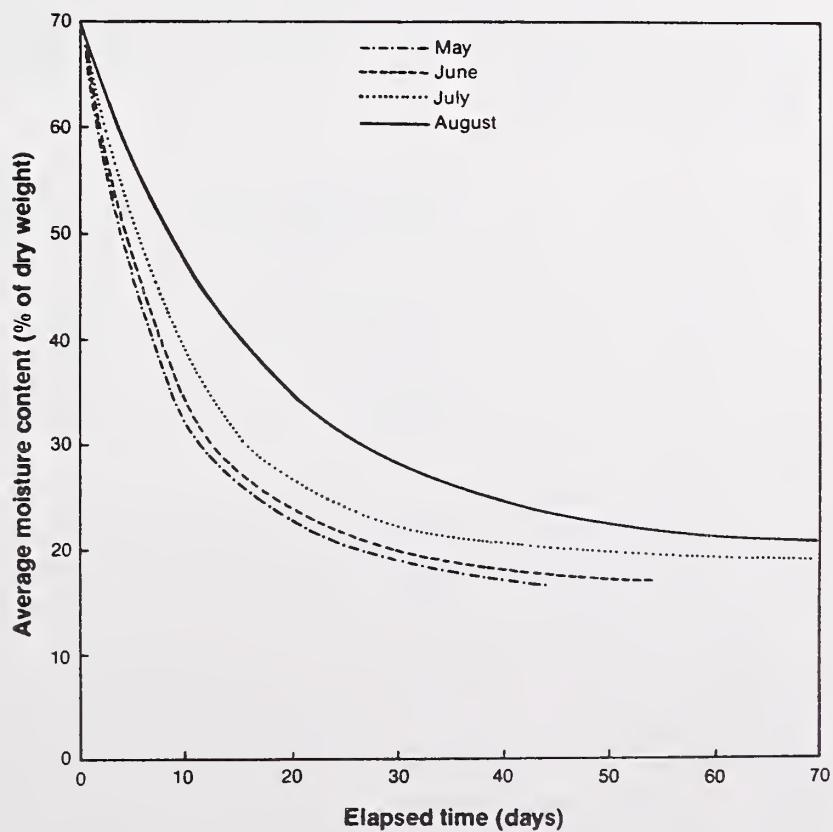


Figure 3.—Predicted moisture content of white spruce lumber while air drying in Fairbanks, Alaska. Based on month drying began (from equations 1 and 2 and monthly average temperature and dew point).

Discussion

Air-drying rates for lumber are affected by temperature, relative humidity, wind speed, and precipitation (Denig and Wengert 1982). The ratio of sapwood to heartwood in lumber affects initial moisture content and rate of air drying. White spruce typically have heartwood with 51 percent moisture content and sapwood with up to 163 percent moisture content (Dobie and Wright 1975).

Air drying produces lumber sufficiently dry to meet requirements for building codes. Based on the results shown in figure 2, however, dry lumber cannot be produced throughout the calendar year. Data for figure 3 indicate that air-dried lumber (lumber having moisture content < 19 percent) could be produced from May through September. Lumber sawn during August to April may not be marketable until the following May if it has to be < 19 percent moisture content.

The derived equations and figure 3 may be useful in planning for air drying in the Fairbanks area. The equations could be used for tracking moisture content of air-drying lumber over time. Most operators would probably find it necessary to have an electric moisture meter so that moisture content of individual pieces could be estimated at any time.

Air Drying or Kiln Drying

If a local mill does begin to produce the bulk of its output in dry lumber, its selection of drying method will be based on economics with the least costly method being the preferred one. Air drying does not require the outlay for the kiln, equipment, and fuel necessary for kiln drying.

An example for a hypothetical sawmill producing only air-dried lumber was developed and is summarized by figure 4. Annual production was assumed to be 7.9 million board feet with production slightly lower in winter months than in summer. Most of the lumber sales are assumed to be during summer months to coincide with the periods of most construction. Drying times, based on figure 3, were simplified as follows:

Month of lumber production	Air dried by end of:
August-April	May
May	June
June	August
July	September

Given these assumptions, lumber inventory required to meet sales is as shown, and average monthly inventory is 6.058 million board feet. If the green lumber is assumed to have an invested cost of \$300 per thousand board feet and the interest rate is 14 percent, the annual cost of maintaining inventory is more than \$254,400.

With a continuously operating dry kiln, sales and production could be balanced by maintaining an inventory of 1.25 million board feet. Annual cost of maintaining such an inventory is \$52,000 given the value and interest rate above. The difference between the two inventory costs amounts to more than \$25 per thousand board feet of lumber produced annually. This is estimated to be more than the cost of kiln drying

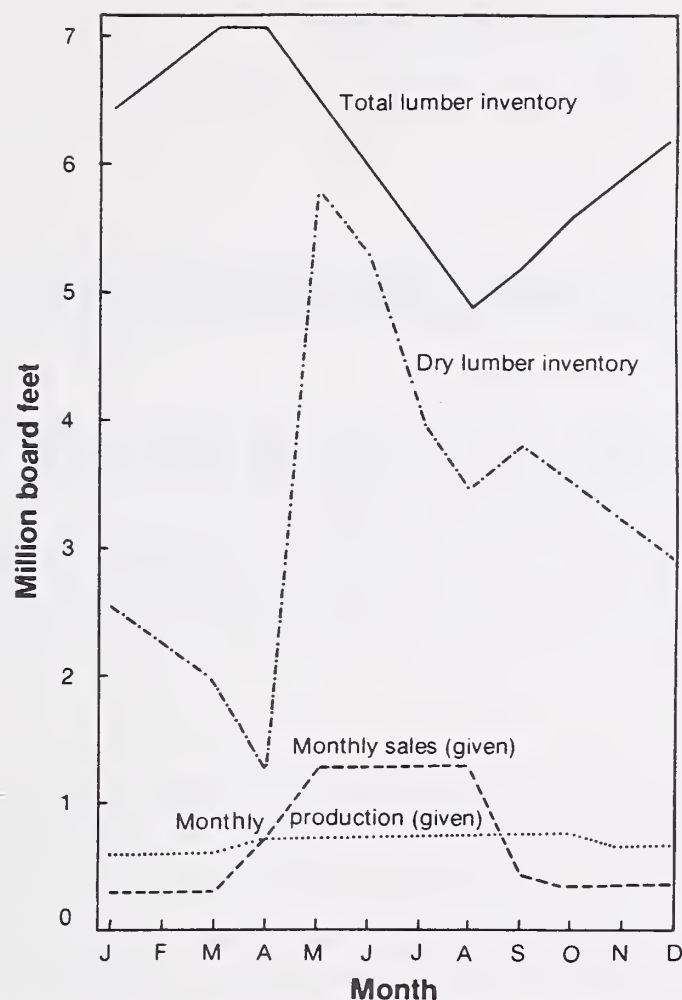


Figure 4.—Average monthly production, sales, and resulting inventory for a hypothetical sawmill producing 7.9 million board feet per year of air-dried lumber, interior Alaska.

lumber if all of the 7.9 million board feet produced annually are kiln dried. Kiln drying has the added benefits of providing better inventory control and of eliminating any wood borers or other insects that may be present in the lumber. Much of the local softwood lumber production is, however, sold as rough lumber. The local price structure for rough lumber versus finished lumber makes it advantageous for local operators to do this as long as total local production remains sufficiently low that most of the production is absorbed by the rough lumber market.

## Conclusions

The daily moisture content loss of 2-inch white spruce lumber air-drying in the Fairbanks area was estimated using data on the initial lumber moisture content and daily temperature and dew point: equation 1 was used for moisture content  $\geq 30$  percent and equation 2 was used for moisture content  $< 30$  percent. These equations were based on data for summer months (May through September) in 1982 when temperatures remained above freezing. Potential for producing air-dried lumber in the Fairbanks area appears to be low from October through April in typical years. Kiln drying in the Fairbanks area may be feasible if local lumber production increases substantially above current levels.



## **Metric Equivalents**

1 inch = 2.54 centimeters (cm)

1 foot = 0.3048 meters (m)

°F =  $1.8 (°C) + 32$

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